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Research, Development, and Acquisition

GUIDANCE FOR INTEGRATED PRODUCT AND PROCESS MANAGEMENT

VOLUME 1

CONCEPT IMPLEMENTATION

PREPARED
BY
U.S. ARMY MATERIEL COMMAND

PREFACE

This Pamphlet is a three volume set prepared by the U.S. Army Materiel Command to provide internalArmy guidance for the implementation of IntegratedProduct and Process Management (IPPM).

This volume covers the concept and implementation of IPPM. It is managerial guidance and should be of primary interest to Army program/project/product managers, matrix support managers and managers of weapon system development. The secondary use is for leadership of the Army Integrated Product Team (IPT), as well as one of the tools for qualification training of people for the IPT.

Volume 1 has drawn heavily upon the Tank-Automotive Command report on Concurrent Engineering Process Support developed under contract number DAAE07-91-G-RO01 and upon the U.S. Army Simulation, Training and Instrumentation Command (STRICOM) Request For Proposal development process. The content has been adapted from the results of a series of AMC Concurrent Engineering Workshops and from the recommendations of the IPPM Working Group.

Volume 2 describes specific actions to be taken in IPPM applications. It provides operational guidance. This volume has been organized into three sections: Section I - Purpose, Section II - Team Composition, and Section III - Integrated Product Team - Integrated Product Team Life Cycle Responsibility.

Volume 3 describes IPPM as it relates to Integrated Product and Process Development (IPPD) and offers tools and practices to aid in implementation. This volume has been organized into three sections: Section I - Introduction, Section II - IPPD Tools and Technologies, and Section III - IPPD Assessment Criteria.

DEPARTMENT OF THE ARMY
HEADQUARTERS, UNITED STATES ARMY MATERIEL COMMAND
5001 EISENHOWER AVENUE, ALEXANDRIA, VA 22333-0001

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Section I. INTRODUCTION

A. BACKGROUND

In recent years American industry has explored a variety of managerial techniques to improve competitiveness. Some of these techniques have focused on particular aspects of the business process, e.g., activity based accounting, and others have dealt with more systemic issues, e.g., quality. From these experiences American industry has recognized that to remain competitive fundamental changes must be instituted. The Army, as a customer striving to get better products, is working with industry to implement progressive changes.

One of the most effective techniques now being applied is Concurrent Engineering (CE). It is a systematic approach to integrating the design of products and related processes. The approach stimulates developers to consider all elements of the product life cycle from conception through disposal, including quality, cost, schedule, and user requirements. (For a more detailed discussion of CE see the “CE Strategy” White Paper in appendix A of volume 3.)

As this technique has gained acceptance, concurrent engineering has also had to evolve and is being replaced by Integrated Product and Process Development (IPPD). IPPD describes the efforts of the Materiel Developer (MD) to develop a product using an Integrated Product Team (IPT). It avoids the implication that the application of this concept is limited to engineering.

The Department of Defense (DOD) acquisition policy described in DODI 5000.2 does address CE or IPPD. It strongly supports the use of IPTs.

Integrated Product and Process Management (IPPM) is gaining acceptance with the Army. IPPM describes the Army concept for managing the system acquisition process. The IPPM concept draws on the systems engineering tools and overlays a management concept that encourages the use of IPTs. The Army interacts with the contractor's IPPD process in its role as a customer and as the IPPM manager. These responsibilities involve establishing performance requirements, managing total program progress and evaluating product quality. The responsibilities extend throughout the product life cycle.

B. CONCEPTS

The first step in applying the Integrated Product and Process Management (IPPM) concept is to identify the Army functions that must be performed. Army functions usually are limited to in-house design/design trade-offs, acquisition strategies/plans, resource management, integrated requirements process, source selection, and contract management/oversight. Most of the available literature on the subject is written for industrial organizations that perform all these functions. Most Army agencies, however, contract out parts of these functions. This pamphlet considers the uniqueness of the Army's situation.

This pamphlet stresses the importance of having integrated product teams (IPT), and the Army and contractor operating seamlessly through the acquisition process. The IPT will evolve from the interface between two teams: The U.S Army Training and Doctrine Command (TRADOC) capability - focused Integrated Concept Team (ICT) which defines the requirements and the Army Materiel Command (AMC) technology - focused IPT which explores emerging technologies. AMC and TRADOC teams will each contain representatives from the other command and both will provide members to the product - focused IPT. Once it is determined that a materiel solution is required, this product - focused IPT is formed. Formation of this team should occur as early as possible after materiel requirement approval. While some changes in the composition of the team may occur, it is important to maintain stability and constancy of purpose.

The team should strive to overcome procedures that have discouraged the integration of product and process. As an example, financial procedures have drawn a distinction between product engineering and process engineering. Product engineering has been considered an allowable expense on weapon system developmental contracts. Process development however has been considered as an overhead cost. As a result, most proposals for Independent Research and Development are for product improvement and not process improvement. This has limited efforts to improve processes.

There is a distinction that should be drawn between the two major concepts discussed in this guide: Integrated Product and Process Development (IPPD) and Integrated Product and Process Management (IPPM). Both have their origins in the concepts of concurrent engineering and are based on acquisition processes involving work by integrated, multidisciplined teams. The IPPM terminology avoids the perception of a single functional orientation of these processes, i.e., engineering or development. System acquisitions by Army are usually accomplished through contracted development programs that lead to production,

sometimes as a follow-on to in-house Army developments. In response, we want our contractors to perform IPPD. While the Army has an interrelationship in the IPPD process, in its role as "the customer," the Army performs IPPM by monitoring and managing overall program progress, and evaluating product quality.

The ongoing DOD effort to reduce the use of military specifications and standards will allow contractors to optimize the fabrication processes and the data management techniques they use. Related to this is the Army's emphasis on using performance specifications and performance oriented Statements of Work (SOW). These will allow the contractor more latitude for developing bid proposals. These and other acquisition improvement efforts are all conducive to the concept of IPPM. The integrated team can foster application of these acquisition improvements by providing the forum for resolving issues that would otherwise be extremely difficult in a sequential acquisition strategy.

Section II. ORGANIZATION AND RESOURCES

A. THE TRADITIONAL SYSTEM

The sequential acquisition system tends to design for product attributes separately. Operational performance is separate from producibility that is separate from maintainability, etc. The multidisciplined IPT approach assures that all issues that are either effected by or have an input into the decision process are considered initially.

The traditional system also tends to compartmentalize individuals and encourage them to defend their particular functional area or skills. With the IPT these individuals serve as team members, with each contributing their skills and experiences.

The traditional system establishes experts with narrow specialties. These expert skills need to be maintained, but their contribution needs to be in support of the "whole" product. Each expert needs to look beyond his or her special area and contribute to the overall design of the product.

The sequential system also creates controversy. As a design is passed from function to function, the specialists identify potential improvements, but must go back and request changes in the last version. Earlier specialists become defensive creating delays and hard feelings. By using an integrated team concept, the specialists have a chance to exchange ideas concurrently and to explore and understand alternatives without being viewed as a critic.

The sequential system reduces the opportunity for downstream functions, like production and logistics, to participate and exert influence on the design approach. Teaming allows all phases of the life cycle to have more voice in the early decisions.

B. IMPLEMENTING IPPM

As an initial step, it is important to advise all of the Army organizations involved with the product of the commitment to apply IPPM. Such a commitment should be sought from Headquarters, Department of the Army/Army Materiel Command (AMC) and the relevant AMC major subordinate commands (MSC) and separate activities. That will help assure their support for the IPT. Identifying a steering committee "Champion" for IPPM at those organizations can also be useful in resolving issues.

Successful empowerment of government Integrated Product Teams (IPT) depends largely on clear support for IPPM concepts from top level management. One way for senior management to demonstrate their support/commitment for IPPM is the appointment of a Steering Committee, headed by a person designated as the conscience of the organization, to oversee the process and report problems that require executive resolution. Government IPPM Steering Committees are made up of decision makers at the organizations senior level. The Steering Committee helps merge the interests of involved agencies with those of the program and provides a forum to address functional area concerns. One of its purposes is to facilitate delegation of authority for decision making at the IPT level by providing a higher level steering committee to quickly resolve major sticking points. It will also resolve any policy issues which may arise as a result of implementing IPPM.

Steering Committees are used in many places to facilitate teamwork. These are management teams dedicated to helping product development teams. They are composed of lead representatives from all appropriate functional disciplines working together with a team leader to build successful and balanced programs, identify and resolve issues, and make sound and timely decisions. Mr. William Perry in his memorandum on "Use of Integrated Product and Process Development and Integrated Product Teams in DOD," strongly supports the use of IPTs. "I am directing a fundamental change in the way the Department acquires goods and services. The concept of IPPD and IPTs shall be applied throughout the acquisition process to the maximum extent practicable." Mr. Perry concludes his memorandum by requesting for the DOD community's "personal involvement and commitment to ensure that the concepts of IPPD and IPTs are effectively implemented." The IPPM Steering Committee is the group that is able to make this happen. The committee conquers obstacles in areas

like material supply or resource allocations; they throw their collective weight against management barriers, they answer questions the teams come up with; and they ensure the teams are focusing on corporate objectives. The IPPM Steering Committee is a strong show of support for the IPTs. They work because they champion the IPPM process.

Steps On How To Implement IPPM Steering Committee:

1. Who is responsible for getting it started: The organization's IPPM point of contact (POC) will initiate all actions required to implement the Steering Committee.

2. Designate a senior management lead: This step is most important in the formalization process. There must be an active involvement of senior management through reinforcing actions responsible for IPPM. The requirement is to solicit the support of a senior level person over your organization (example is a Tech Director) who supports the IPPM process. The senior level person is required to facilitate the success of the IPPM Steering Committee, a group of senior managers representing a cross section of the organization.

3. Steering Committee Function: The steering committee shall be knowledgeable on IPPM processes, team training (as required), and development of team charters (see for example the AMC IPPM charter in volume 2, appendix B).

• **Training** in team dynamics for both government and contractor team members is extremely important. This training should reduce the conflicts between multi-disciplined and empowered IPT and conventional management practices. In addition, facilitators may be needed to keep the team's IPPM process focused. There may also be training needed to clarify the relationship that is to be established between the Army and the contractor.

• Sources of training information:

- IPPM Proponent at your MSC.
- Local Training Representative.
- IPT Home Page : http://www.stricom.army.mil

The TRADOC-led Integrated Concept Team (ICT) with membership from AMC begins the teaming process and is followed by the Material Developer-led Program IPT where TRADOC is now a member. Members need to understand the basic need for the product and establish a continuity of purpose. The team should take time to learn how to operate effectively. Team leadership may need to change as the product progresses throughout its life cycle. Members should need to be aware of these dynamics.

Another important step for implementing IPPM is identifying the communication techniques that will be used. Team members need to be able to rapidly and effectively exchange ideas.

The use of IPTs should be identified in the master planning for the product and in contractual documents. Work-year requirements, financial needs, and training will need to be planned well ahead to assure IPPM is supportable throughout the life cycle.

Both contract language and contract incentives should consider the integrated design and development process. If a prospective contractor is going to be evaluated for internal use of integrated design and management processes IPPD that will need to be explained in sections L and M of the request for proposal (RFP). Different approaches may be required for nondevelopmental items (NDI) than for major system developments. The ability to tailor the acquisition strategy and contract requirements to the reality of the situation is an important aspect of the IPPM concept.

Creating "partnering" charters or memorandum of understandings are also encouraged. These agreements between the Army and contractors provide a commitment to bring issues up early and to try to resolve them at the lowest organizational
level. The agreements can also be used to identify the mechanisms for resolving conflicts.

As the IPPM process begins to take hold, it will be important to evaluate progress. This requires having benchmarks for success and the tools for evaluating whether those benchmarks have been achieved. Identifying these benchmarks is difficult since they will need to be tailored to the peculiarities of the product.

C. HIERARCHY OF INTEGRATED PRODUCT TEAMS (IPT)

The following discussion describes the multiple levels of IPTs that could exist on a typical major program. Many programs will not require this level of hierarchy.

The Office of the Secretary of Defense (OSD) has called for the creation of "Overarching IPTs" (OIPT) comprised of Milestone Decision Authority level personnel to provide program insight and assistance through continual interaction. The OIPTs replace the pre-Milestone Decision Review (MDR) committees. The Army has also defined an Army System Acquisition Review Council (ASARC) Coordination Team (ACT) to serve as their OIPT, for ACAT IC and II systems. In the case of DOD level systems (ACAT ID), the DOD and Service OIPTs should merge into a

single joint OIPT. DOD has also defined "working level" IPTs (WIPT) comprised of DOD and service action officers, for ACAT ID systems. These working level IPTs will provide advice to the PM and help prepare program strategies and plans. For each major program, there will be an OIPT and at least one WIPT. WIPTs will focus on a particular topic, such as test, cost/performance, contracting, etc. An Integrating IPT (IIPT), a type of WIPT, will coordinate all WIPT efforts and cover all topics not otherwise assigned to another WIPT. WIPTs will usually be chaired by the program manager (PM) or PM designee. OIPTs and WIPTs must interact with the PM and contractor system-level IPTs and probably the commodity-level IPTs as well. With the goal of reducing program oversight documents, it is necessary for the OIPT/working level IPT members to have regular, unrestricted access to PM and contractor IPT members and data. Ideally, the OIPT members will periodically attend system IPT meetings and activities to keep abreast of actions and provide input.

For ACAT IV programs an OIPT will reside at the MSC level. WIPTs and IIPTs should not be used.

Initially, the Government IPT, chaired by the PM, is formed to develop contract requirements and RFPs and to evaluate contractor proposals, and perform program management. Depending on the size of the program and management approaches, the PM IPT may also evolve into sub-IPTs to address specific components or functional areas. The PM IPT(s) may be separate from the contractor IPT(s); however, they should to the maximum extent practical share members and coordination/interface must occur between the two groups. This membership provides instantaneous customer input and feedback into team decisions. PMs should consult with their local command councils regarding possible restrictions on joint Government/contractor teams.

While many development programs can be effectively managed by a single IPT, others are large, highly complex, and involve large groups of people at multiple geographically distinct sites. In the latter case, no single IPT can manage the entire development effort and multiple IPTs must be used. A standard approach used extensively by contractors is to initially establish a system-level IPT at program inception. This IPT handles proposal preparation and costing, initial requirements determination, development of program plans and schedules, conceptual design, and a system work breakdown structure (WBS) description. Later, commodity-level IPTs are formed for each of the major subsystems identified in the WBS. Each commodity IPT has its own complete set of functional area members, responsibilities, goals, and resources. Upon creation of the commodity IPTs, the system IPT takes on a new role--that of system integrator. The system IPT must ensure that communication processes and tools exist for use by and between commodity IPTs, and that

interfaces between commodities are defined and maintained. Issues impacting one or more commodity IPTs will be raised to the system IPT for resolution. The system IPT will also track overall system cost, performance, and schedules, and monitor each commodity IPT's contribution to those goals. Each commodity IPT should have a member on the system IPT.

It is important that the commodity IPTs be "product-focused" and have all applicable functional areas involved. In some cases, however, one or more "function-focused" IPTs may be created. An example might be in the area of software development where many of the subsystems will utilize software, and common ground rules must be used by each commodity IPT. In this case, a software IPT might be created to develop the common ground rules and procedures to be used by each commodity IPT. The composition of the software IPT would be the software members of each commodity IPT. Function-oriented IPTs should report to the system IPT. Care must be taken when using function-oriented IPTs that their single function nature doesn't end up recreating the traditional "stovepipe" bureaucracies. They should only be used where a common function/activity is used by many commodity IPTs and must be standardized.

Figure 1 shows a graphical representation of one possible configuration of multiple IPTs and their relationships/ interfaces.

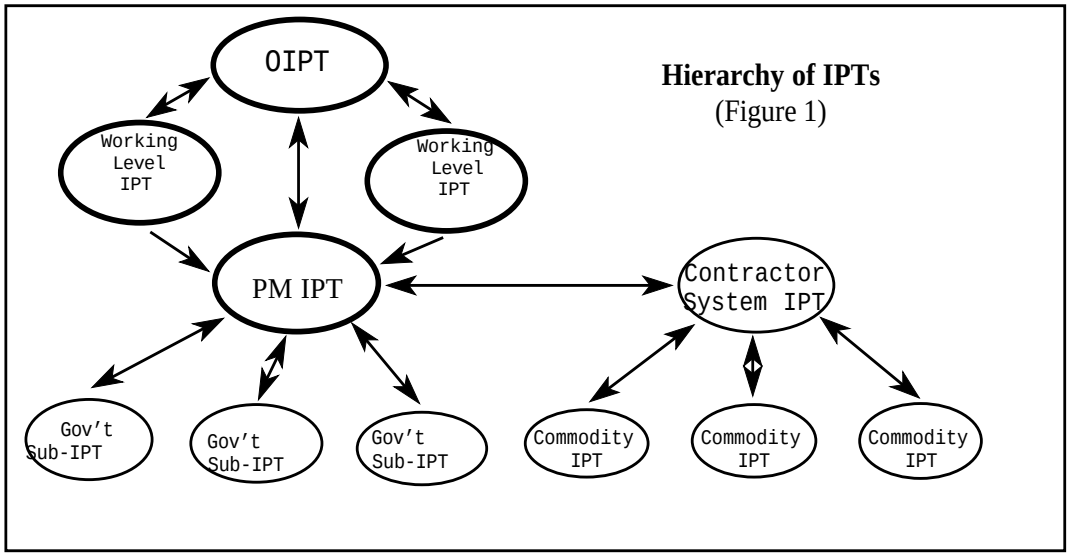


Figure 1.

Exact mechanisms and procedures for enabling team interactions vary, but since large geographical distances separate teams and possibly even team members, physical co-location of all teams/team members is not possible. Virtual teaming technologies such as teleconferencing, E-mail, Internet Homepages, computer-aided design (CAD), and common data bases will be required. Use of these technologies is particularly important for the Government OIPTs and WIPTs since they are not envisioned to have frequent or regular meetings. Generally, they would only meet in order to work a specific issue. Program status updates should be provided to these individuals through other means.

In summary, the decision whether to use multiple IPTs (and if so, how many) must be made by each program based on its size, complexity, number of contractors/subcontractors involved, team size, effective span of control for team sizes, and methods available for communication. The critical issue for multiple teams to operate effectively is good communication technologies and procedures. Private industry has often found it useful to develop a "Communications Plan" as an early program management document. The Communications Plan describes what information needs to be shared between teams and within teams and how that sharing will occur.

D. TRAPS THAT MAY OCCUR WHILE IMPLEMENTING IPPM

The application of IPPM provides many benefits, but there are traps that can occur that will interfere with its effectiveness. For example--

- **Inadequate resources.** The IPPM concept requires an up-front commitment of resources that may be greater than what is required for the sequential process. This should reduce the down stream resource needs. If management is unable to commit to those resources then IPPM benefits will be hindered.

- **Inadequate team training.** Without adequate training team members may not be able to set up an effective team.

- **Inequality of team members.** The team must be viewed by all as composed of equals. Each team member needs to feel free to express their views.

- **Transitioning of team leadership unclear.** The process for evolving the team leadership as the product progresses through the acquisition cycle needs to be clarified early in the process. That leadership should transition to be consistent with the function that has the primary interest at that phase in the life cycle.

- **Directing implementation of IPPD.** A series of "approved, recommended, or best practices" for applying IPPD should not be contractually imposed. These practices will become standards by implication and contractors will be hesitant to deviate from them for fear of being found contractually non-responsive. The desired contractor should already have established an IPPD culture and should not need steps for implementation.

Section III. ACQUISITION MANAGEMENT

A. THE TRADITIONAL SYSTEM

This section discusses the IPPM actions that the Army materiel developer must perform. These actions must successfully motivate contractors to perform IPPD and to interface most effectively with contractor IPTs.

The traditional Army development system does not encourage contractor innovation and suggestion of changes to Army mandated approaches. Attempts to propose something different risk the offeror being disqualified as a "nonresponsive" bidder.

The traditional system encourages the use of serial, functionally fragmented development approach and that this approach be used by the Army for acquisition strategy planning, contract requirements' development, source selection, program management, and evaluation. This must change to an integrated approach to operate effectively with the contractor's IPPD methods.

B. IMPLEMENTING IPPM

IPPM begins with forming, training and team charter development (see volume 2, appendix B) for each specific capability focused ICT and the standing technology focused IPTs. The appropriate technology focused IPT (if in place) aligns with the capability focused ICT and assists in development of the appropriate requirements documents. The product focused IPT is formed and trained once a materiel solution is determined to be the desired approach for providing a capability. After the team charter is completed, determine the product requirements (System Specifications) and Acquisition Strategy (AS). This IPT will be the precursor to the Program Management Office (PMO) and should transition into the PMO. All functional areas must be represented on the IPT. The determination of functional area applicability will be refined as the System Specification and AS are developed and approved. An especially important IPT member is the Combat Developer (CD) or product user who

should transition from the Integrated Concept Team (ICT). Their input is critical to determining product performance requirements and conducting cost/performance trade-off studies throughout the life cycle.

The next step for the IPT will be to develop an integrated Request for Proposal (RFP). Integrated RFPs consider all the functional area requirements that have resulted from thorough systems engineering, value-added, and trade-off analyses. The goal is to determine the minimum essential requirements that must be described in the RFP to enable the contractor to develop the best product. Each proposed requirement must be evaluated for its value, cost, associated risks if not used, and alternate methods to achieve the same goal. An integrated requirements evaluation typically finds that fewer requirements exist than have traditionally been requested. Product specification and RFP requirements must be based on performance needs rather than stipulating design parameters and "how to" requirements. For typical programs Bidders will be asked to explain in their proposals their design methodologies and processes for the entire life cycle (e.g., cost control, system engineering, testing, production planning, logistics support planning, configuration management, etc.). A primary aspect to be evaluated in the offeror’s proposal is their Integrated Process and Product Management (IPPM) approach. This is a management technique that simultaneously integrates all essential acquisition activities through the use of multidisciplinary teams to optimize the design, manufacturing, and supportability processes. The Integrated Master Plan and Integrated Master Schedule are effectively subsets of this approach in that they provide the plan to be used by the contractor and the corresponding schedule.

The **Integrated Master Plan (IMP)** is an event-driven plan that documents the significant accomplishments necessary to complete the tasks defined in the Statement of Objectives (SOO) or Scope of Work (SOW) and ties the accomplishment to a key program event. Additionally, exit criteria are provided for each significant event to facilitate the assessment of successful completion. The program milestones depicted in the IMP are event oriented and represent integrated product development that encompasses all disciplines (e.g., engineering, test, manufacturing, management, etc.). The IMP is oriented by product using the Work Breakdown Structure (WBS) numbering system and contains no calendar information. The IMP is normally contractually incorporated.

The **Integrated Master Schedule (IMS)** is a detailed, time-dependent, networked, task oriented schedule of the effort required to accomplish the complete program and its relationship to the events, accomplishments, and exit criteria identified in the IMP. An integrated program network schedule includes events defined in the IMP which are detailed to include all of the tasks and activities required to complete each milestone. The

IMS will be directly traceable to the IMP and the WBS. The Government solicitation should contain an initial draft program IMS which should be limited to major milestones, activities, and events. The offeror(s)' proposal should build upon the initial IMS and include a lower level of detail reflecting the specific tasks and activities based on the proposed approach and resources required to develop and/or produce the system. The IMS is not normally part of the contract, but is updated periodically by data submittal.

Another useful feature of the IMP is that it provides the program office with visibility into how the offeror has captured his technical and management processes in his proposed approach. The IMP should reflect the outputs of the processes that are critical to achieving the objectives of the program. If, for example, manufacturing is a critical technical process for the program, the IMP should include such outputs as verification of manufacturing process capability, tool proofing, etc. In rare instances, the program office may determine that there are certain process attributes that cannot be readily captured as IMP outputs. In such cases, offerors may be requested to identify these attributes in a brief, summary-level process description in a separate narrative section of the IMP.

Given that the IMP and IMS provide all tasks considered to be essential to successfully complete the program as well as the corresponding schedule of those events, it stands to reason that these two documents can be used as the cornerstone of not only the contractor's proposal but are also significant portions of the ensuing contract. It is envisioned that, with the maturity of this process, the IMP/IMS may supplant the technical, management, and/or schedule sections of proposals. Perhaps the most unique feature of the IMP/IMS process, when used in conjunction with a Statement of Objectives, is that the contractor is not prompted to respond to superfluous instructions to offerors that have historically allowed professional "brochuresmanship" to flourish.

While a number of commands have produced draft IMP/IMS guides, none have been fully coordinated and approved for dissemination throughout DOD. Initial indications are, however, that this process produces better, more concise proposals that will inevitably lead to better program performance through the tracking of those program tasks determined by the parties to be essential to successful program execution.

The goal is to allow contractors maximum design and management freedom, while gaining enough insight to conduct best value source selection.

Care must be taken to build incentives into the RFP so that both the Army and the contractor can benefit from implementing IPPM. Since the development contractor will soon become a part of the team, it is wise to allow prospective bidders to comment on the RFP while still in draft form. Such participation can further refine the Army's goals and requirements by identifying contractor known obstacles, cost drivers, and alternatives. The final RFP must also explicitly state that contractors are allowed and encouraged to propose alternatives to any RFP requirement and product improvements to the product performance specifications. The Army must accept that some alternatives/ improvements may cost more money, but improve product quality or performance. Cost/benefit analyses must be conducted in these situations to determine their merits.

It is important for the government to inform potential offerors about the Government’s IPPM concept of operation. In the spirit of Acquisition Reform the Government should not mandate processes, however, the offeror should be aware of how the Government conducts business. This information can be relayed by several methods including the Executive Summary which would be attached to the RFP, Commerce Business Daily announcements, or as a separate attachment to the solicitation. Sample wording and topics are contained in appendix A to volume 2.

The government’s method of evaluating the offeror’s IPPM approach is part of the source selection process. Therefore the structure of section L must adequately define information necessary to evaluate how the offeror will integrate each critical process into an overall integrated management approach. Along these lines the criteria in section M should reflect the relative importance of IPPM. Sample language for contract sections L and M are contained in appendix A to volume 2. Sample language for the standards portion of the Source Selection Plan is also provided in appendix A of volume 2. Each team must tailor this language to fit their specific acquisition.

Conconcurrent with development of the integrated RFP and AS is the Source Selection Plan (SSP) and associated evaluation criteria. Prospective contractors must be convinced that the Army is trying to award contracts based on superior technical and management approaches and best value, not just lowest cost. The Army's evaluation criteria must track with the contractual requirements and show appropriate weighting. Using performance based system specifications and RFPs means that contractors have much more latitude on proposing innovative approaches. However, their use requires much more technical understanding by the Army Source Selection Evaluation Board (SSEB). Again, the IPT, now serving as the SSEB, must evaluate contractor proposals that may be radically different from each other and from past approaches the Army is familiar with. Care must be taken that proposals are not dismissed out-of-hand

just because they are different. Once the Army IPT/SSEB has selected the "best value" contractor, the technical and management approaches described in their proposal should be incorporated into the contract.

It is equally important that the Army IPT work with the contractor after contract award in a way that encourages effective program management and product development. It is at this point that the Army IPT and contractor IPT (assuming they are using this approach) must effectively integrate. Integration could take one of several forms. Government and contractor personnel could merge into a single homogeneous IPT with daily interactions and joint decision making. Such an arrangement would probably require physical colocation of personnel at the contractor's facility. In the future, use of next generation electronic data transfer, E-mail, conferencing, and design analysis capabilities should allow for physical separation of team personnel into a "virtual team" environment. An alternative approach could also be parallel Army and contractor IPTs who maintain close detailed contact with their counterparts, but are not permanently colocated. These approaches require both the Army and the contractor to break away from the traditional strictly functional area-oriented management and product development methods, to integrated methods. Functional area specialties will continue to exist. However, in an IPT environment their efforts and decisions are not made separately, but instead in a team environment with input and tradeoff considerations from all team members.

Integrated Army/contractor IPTs will change the manner in which design evaluations are conducted. Rather than formal design evaluations at fixed points in time, the integrated IPT uses multiple, successive performance evaluations that occur continuously. Performance evaluations should be commodity oriented rather than functional specialty oriented. The Army participates in these evaluations as a team member, with real time visibility into the design and process planning. This allows the Army the chance to propose changes or register concerns before designs and processes are solidified. Only significant concerns/issues that cannot be resolved at the IPT level need to be surfaced to upper management at program progress evaluations. This process should be called out in advance either in the Army/contractor IPT charter or the contract. Such an approach is very alluring to the Army, but will require much more "hands-on" effort and direct involvement than has traditionally been the case. Section IV provides a more detailed discussion of the performance evaluation methodology.

The Army IPT members must provide the contractor feedback on the effectiveness of their IPPD approach. IPPD is still a new enough philosophy (and will continue to be for some time to come) that many contractors and most Army personnel do not have much experience with it. Both sides must periodically evaluate the IPPD/IPPM process and make

changes if needed. Such evaluations should occur at program progress evaluations along with evalua- tion of top level program technical, schedule, and cost progress.

All of the above steps for applying IPPD/IPPM assume a competitive development situation. If no competition exists, the Army may need to direct use of IPPD approaches if the single bidder does not propose them. Additionally, the Army may have to help the contractor to set up and use IPPD methods if the contractor has no prior experience in this area.

Production contracts generally have no provision for engineering activities necessary to improve the product or the process. This is a real concern for production of military unique items, where there is no commercial market to drive product improvements. Traditional Value Engineering (VE) incentives would not be applicable if product performance specifications are used by the Army rather than detailed technical data packages (TDP). By using performance specifications, only product performance changes will need Army approval. All production process choices and noncritical design changes are left to the contractor. The incentive in these cases will be that process efficiencies will lead to lower prices and, coupled with good past performance, will lead to contract awards.

C. TRAPS THAT MAY OCCUR WHILE IMPLEMENTING IPPM

• **Army does not use IPPM themselves.** One danger is that the Army will expect contractors to use IPPD approaches, while the Army does not form IPTs, develop integrated requirements' documents (product specifications, ASs, RFPs, etc.), or allow for integrated product development. The Army must suppress the tendency to monitor progress along functional lines, to conduct design evaluations function by function, and to mandate accounting methods that inhibit IPPM. If this occurs, the result will be poor source selections, confused product development efforts, and frustrated Army and contractor program personnel. Both sides will complain that the "other people" are doing business in an entirely different way, and the benefits of IPPD will be lost.

• **Army asks for IPPD in RFP but awards to traditional approach bidders.** It will not take long for contractors to pick up on the fact that the Army may ask for new and innovative IPPD approaches in the RFP, but still award contracts based on lowest

cost and traditional approaches. If the IPPD/IPPM/IPT approach is to really work, then Government commitment must be real.

• **Contractor proposals describe an IPPD approach that is theoretical with no first hand experience.** The possibility of contractors promising more than they can deliver has always been a problem for SSEBs. This will be an even greater concern in an IPPD environment because more authority will be granted to the contractor with less contractual Army oversight. A related trap is if contractors parrot back the IPPD requirements without making the internal cultural changes needed to operate using IPPD techniques. It is important that the SSEB perform a thorough technical evaluation of each proposal, become familiar with IPPD techniques/methods and what can realistically be done, and look closely at contractor past performance. Government expertise will grow as IPPD/IPPM is used on more programs and lessons learned are transferred, but in the meantime we need our best people on SSEBs.

• **RFP asks for IPPD but also contains traditional "how to" requirements.** To appease higher headquarters, RFPs may contain an IPPD requirement but also contain many traditional "how to" requirements that dictate design and management approaches. This situation is counter to acquisition reform and will probably be more expensive and less effective than the sequential acquisition process.

• **Poor incentive fee or award fee criteria.** Under the IPPM philosophy, the driving force behind incentive/award fees should be the accomplishment of a successful engineering product development. Concurrent product and process development, full life cycle design considerations, and continuous improvements should be the focuses. Unfortunately, some contract incentive criteria can disincentivize contractors from using IPPD. For example, incentivizing only development cost can cause the contractor to not perform needed design analysis, testing, and alternatives examination. Incentivizing meeting of schedule milestone events such as design evaluations causes contractors to meet those dates whether they are really ready for that event or not. Examples of better contract incentives include: evaluation of the effectiveness of the contractor's IPPD methods, the number of engineering change proposals (ECP) occurring late in development and whether their occurrence can be traced to poor IPPD practices, and how much the contractor exceeded the original performance requirements.

Section IV. DESIGN PROCESS

A. THE TRADITIONAL SYSTEM

In the past, the sequential development of designs produced items that did not account for the full life cycle of the product. The development of these items was costly and time consuming since many changes were necessary throughout the development of the design.

Different specialty groups were presented with the design in a sequential manner, and changes were made that often negatively influenced other areas of the design. In addition, some aspects of the life cycle of the product were never even considered. This type of development is called an "over the wall" design process, and often forces costly design changes late in the development process.

Major government-mandated design evaluations (such as the preliminary or critical design evaluation) were conducted on a specialty basis. The agenda for the evaluation was structured along specialty lines rather than concentrating on the potential of the weapon system to meet operational performance objectives. Both the Army and the contractor tended to hand over all specialty characteristics to the specialists in that particular area. Sometimes, design review agendas were broken out into parallel sessions so that like-minded specialists held discussions in separate rooms.

B. IMPLEMENTING IPPM

The following discussion applies to any product development activity whether performed by a contractor, a government agency, or a mixture of the two.

1. Teaming. The essence of IPPM is that all functional areas of a full life cycle product should be integrated. The most important member of any IPT is the final customer--the user. IPPM should be applied at all points in a product's life cycle, and at every level of design detail. However, the

maximum benefit of IPPM is a result of implementing it at the beginning stages of the design concept.

The success of IPPM depends highly on the proper application of IPTs. These teams should include representatives from all functional areas of a full life cycle product, including internal and external organizations (i.e., producibility, maintainability, safety, users, suppliers, vendors, etc.). It is essential that a meaningful two-way dialog between Army and contractor personnel occur on a continual basis.

The optimum IPT would have access to all functional areas. It is critical to set up an organizational structure for the teams that allows for the highest level of participation possible. The most difficult part of implementing IPPM is deciding what functional areas can or should be represented at any given time.

A common, and often successful, solution to this issue is to have "core" teams staffed with functional area representatives who are critical to a specific portion of the product. This core team is supplemented with "shell" support personnel that represent the entire life cycle of the product. This support group can be called upon at different levels of participation during the design. For example, they might participate at weekly IPT meetings where issues pertinent to the program are raised and addressed. Active involvement is extremely critical in the early stages of any design. Shell support can also be made available to take part in the design when the core team feels there may be a deficiency. As a minimum, all functional areas must be represented at performance evaluations. As a minimum, communication with "shell" members should be done through e-mail, minutes, etc., in order to inform them of all IPT actions. It is important to keep in mind, the further the program is along in the design, the more difficult and costly changes become.

2. Design Reviews and Performance Evaluations. As IPPM becomes part of the Army's way of doing business, the need for conventional design review schedules will disappear. Continual contractor and Army interaction will occur throughout design maturation. Informative evaluations may be given by a program IPT for upper management upon request. The Army and contractor IPTs will be integrated, since both Army and contractor will be directly involved with the design on a real time basis. This change will not occur instantaneously. The evaluation process currently used should be allowed to evolve over time.

a. Traditional Approach. Historically, the Government has required several incremental events called design reviews (SDR, PDR, CDR) which were to be conducted and documented by the contractor. The subjects of these reviews included detailed development specifications, preliminary product specifications and sometimes even process and material specifications to assure that critical processes and materials can be replicated by follow-on contractors. The contractor prepared the minutes of the reviews, which were then approved by the Government. This traditional approach drew concerns from two directions: first, that the contractor's responsibility for design was compromised by the Government approval of the design review results; and second, that the meeting was not a thorough technical review since it focused on program status type issues such as: "How much of the design is completed?", "When will certain events (tests, demonstrations, etc.) occur?", and "How much money has been spent?" While it was agreed that such issues are important, the concern was that the design did not receive thorough technical reviews by independent peers, representatives of other functional disciplines and the customer, and, most importantly, that the review occurred after the fact as an inspection of a completed product.

b. IPPM Approach. Following are guidelines and suggestions for applying IPPM/IPTs to contractor initiated design reviews and government performance evaluations. (All future references to 'design reviews' will indicate contractor initiated design reviews.) PMs should consider, select, modify, improve, and add to the ideas provided below as they tailor their own IPTs to match their programs.

• **Government Participation.** Government representatives have a legitimate role on contractor IPTs. Government representatives are the "voice of the customer." They are able to explain the requirements and explain the Government's position when trade-offs are being explored. They can assist the contractors when making sensitivity analyses (weighting the effect of changes on dependent variables). This type of customer feedback must occur early and continuously in the development effort. Government participation on IPTs in no way absolves the contractor from the responsibility of meeting design and contractual requirements. Unresolved issues pertaining to performance or contract requirements should be addressed to the contractor through the contracting officer. In all other matters, Government input should be considered by the component level or system level IPT as any other IPT member.

•• **Continuous Performance Evaluations.** With government participation in contractor IPTs, we will have continuous insight into progress toward achieving performance requirements. The traditional emphasis on performance specifications, IPT meetings, electronic information sharing, etc., will minimize the need for program progress evaluations. Performance specifications will require the contractor to carry more responsibility for the design effort. There will be less need for Government oversight, i.e., less need for Government approval of plans, specifications, procedures, reviews, and reports which had the effect of relieving the contractor of design responsibility. In relation to contractor performance, the purpose of the government representative(s) on the contractor's IPTs is/are to assist the parties in understanding the contract requirements, offering lessons learned, facilitate timely issue resolution, and to allow the government to gain early/continuous insight into the contractor's performance. These evaluations can be used as a vehicle for higher headquarters (DA/OSD) staff to gain insight into program status.

•• **Contractor Initiated Design Reviews.** Component level IPT reviews are an appropriate forum to debug the design. Government representative(s) will generally participate in these reviews. IPT members examine the design for adequacy against design requirements and discuss opportunities for design improvements. IPT members representing functional areas must regularly evaluate the design, look for potential problems relating to their functional area, and attempt to resolve issues

in a multidisciplined environment as they arise. The Government has a role in the problem resolution process. At contractor design reviews, if a problem is surfaced or alternatives are being evaluated, government IPT members can voice opinions and offer possible solutions for consideration by the working level IPT. Unresolved issues can be brought to the performance evaluations held by the system level IPT.

Design Traceability. Throughout the design process, traceability must be maintained by the contractor between the design and product requirements. The IPT must know which aspects/parts of the design satisfy customer requirements so that when those design aspects are changed/deleted, the IPT can check for performance impacts. A system should be in place to provide a historical record of all design changes and their rationale. This information is invaluable when evaluating future design changes or as "lessons learned" for other programs.

3. Tradeoffs. Tradeoffs are an important part in the creation of a successful design. By using an IPT to define the goals and boundaries of a trade study, complete information should be available to make the final selection of design options. All the important issues of the full life cycle product should be identified by the IPT before the initiation of the trade study. Major tradeoffs among user needs, producibility, maintainability, environmental compatibility and other issues occur based on the information researched. All tradeoffs rationale should be adequately documented. Wherever practical, multiple concept designs should be investigated. A single concept makes the tradeoffs among competing design parameters far more difficult to identify and important options may be overlooked. The overall system design should be kept flexible enough to adapt to the options under consideration in the trade studies. The elimination of the use of military specifications/ standards should be actively practiced to allow for greater design flexibility.

Various modeling and simulation techniques can create "Virtual" prototypes that make it feasible to add producibility, maintenance and support, environmental, and other considerations to the design process. These techniques can create multiple concept designs that fully apply the IPPD concept and are affordable. Whenever possible, past manufacturing, test, and support information should be available to help in design considerations. With the increased emphasis on simulation and modeling, the test and evaluation community will become a vital participant in the IPPD process.

C. TRAPS THAT MAY OCCUR WHILE IMPLEMENTING IPPM

1. Teaming. Often when multifunctional teams are formed, the people who are placed on those teams have not been exposed to the people and disciplines represented. When this happens, the group will go through a phase where working relationships and leadership roles are established. Besides having a technical chairman, it is important to have the IPT supported by a facilitator who is familiar with group dynamics and teaming practices. The facilitator should ensure that the inputs from all team members are considered. Teaming/group dynamics/IPPM training should be provided to all IPT members, so that the benefits of teaming can be realized.

2. Performance evaluations. When all members of a multifunctional team are encouraged to participate in a design, many questions and issues will be brought up, and could be discussed for an excessive time. Setting a specific agenda for meetings and performance evaluations should create a structure that allows for the discussion of issues. Also, this structured agenda does not allow the discussion time to be dominated by any one specific point. Time limits should only be stressed by the meeting facilitator or chairperson when the discussion becomes repetitive, or a consensus cannot be reached. The reason multifunctional teaming is successful is because critical issues may be brought up by completely unexpected sources, despite areas of expertise. For this to occur all team members must be given the opportunity to contribute.

3. Tradeoffs. All members of an IPT should help in completing a trade study and coming to a solution that is best for the overall design. The problem is that IPT members from different specialty areas may be competing against each other to optimize a specific part of the design. A plan should be developed and set before the design begins to manage conflicts between members of the IPT.

Section V. TAILORING TO ACQUISITION STRATEGIES

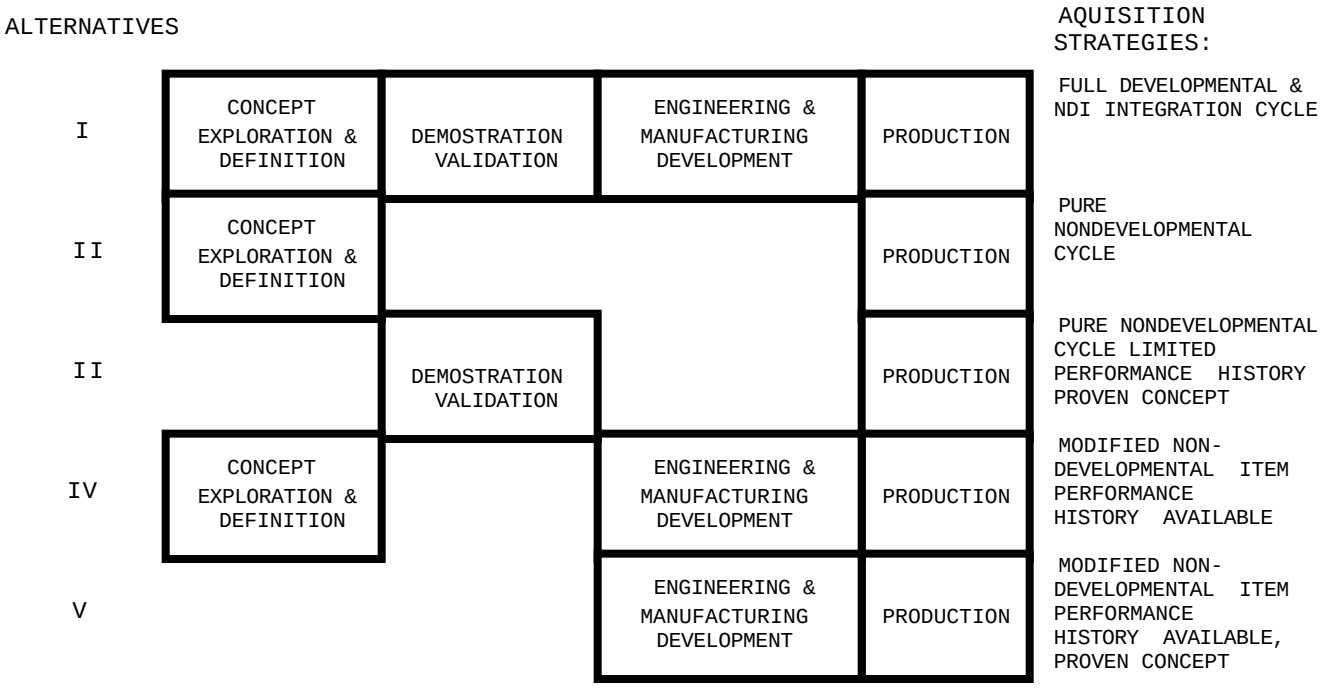
The concept outlined above covers the traditional, full development cycle of DODI 5000.2. There are alternatives to that strategy, such as NDI, preplanned product improvement, technology insertion, etc., which avoid all or part of the developmental cycle by adopting items that have already been developed and tested. These NDI strategies affect the way that IPPM should be practiced.

The acquisition strategies, shown in figure-2, describes the full developmental strategy (Alternative I) and four alternate strategies. When an NDI has an adequate performance history and it fully meets its intended use, then alternative acquisition strategy II should be used.

Alternative III describes the acquisition strategy where an NDI may fully meet its intended use, however, only limited performance data exist to verify compliance. Here a limited Demonstration and Validation phase may be required. Alternative IV covers the acquisition strategy where past performance data indicates that the NDI does not fully meet its intended use. Here the concept may need to be altered and the item modified to fully comply. The Concept Exploration and Definition and Engineering and Manufacturing Development (EMD) phases are warranted to reassess the concept and to modify/develop the item. Alternative V describes the acquisition strategy required when adequate performance data is available to prove an NDI concept can achieve its intended use with modifications. Here only an EMD phase is necessary to modify/develop the item prior to production.

In addition to the alternative acquisition strategies presented above, there are three fundamental types of NDI, "pure" NDI, NDI with some modification, and integration of NDI components into a new system. The first type involves the purchase of an "off the shelf" item from a commercial or other military source. The second involves some ruggedization or militarization of an existing item. The changes involved are usually straightforward. The third type of NDI basically follows the developmental life cycle model. Some steps are shortened or eliminated since the hardware already exists, but interface hardware, software, Integrated Logistics Support (ILS) products, etc., should still be developed and tested. This leaves the first two versions as different types of approaches and acquisition strategies.

The biggest impact that IPPM and IPTs have on NDI development strategies is in the areas of market investigations, alternative evaluations, and acquisition strategy tailoring. A properly staffed IPT is in the best position to evaluate existing items to determine their ability to meet the new system requirements. This is especially true if the IPT developed the system requirements to begin with. If the market investigation yields a decision to use an NDI, the IPT must then tailor the acquisition strategy to fit one of the above alternatives.



PREREQUISITES:

- **CONTINUOUS USER INVOLVEMENT**
- **USE OF COMMERCIAL PRACTICES**
- **INTEGRATION OF PRODUCT/PROCESS DEVELOPMENT**

Figure 2.

A. PURE NDI

The major functions of the IPT for this acquisition strategy are to--

- Conduct the market investigation, determine if an NDI meets the user needs and or the need can be adjusted to accept the NDI.
- Determine that no modifications are required.
- Assist in the development of the performance specification and the RFP.

- Evaluate deployment plans and determine that all essential materiel and documentation will be available to support the fielding of the NDI.

- Assist the Program Manager (PM) in the conduct of the deployment readiness evaluation.

B. NDI WITH MODIFICATIONS

The major functions of the IPT for this acquisition strategy are to--

- Conduct the market investigation, determine if an NDI meets the user needs and/or the need can be adjusted to accept the NDI. In this case the result will be that no existing item meets all user needs, but one or more come close and some modification will be required.

- Assist in the development of the performance specification and the RFP.

- Conduct an integrated performance evaluation as part of the source selection process to determine if the contractor's modifications meet minimum needs.

- Perform an integrated performance evaluation of NDI test results to determine if the system is suitable for fielding.

- Validate deployment plans and determine that all essential materiel and documentation will be available to support the fielding of the NDI.

- Assist the PM in the conduct of the deployment readiness evaluation.

C. INTEGRATION OF NDI

This acquisition strategy is a phase adjusted version of the traditional development cycle. The major functions of the IPT for this acquisition strategy are to--

- Tailor acquisition phase activities to satisfy the requirements.

- Develop the system performance specification and RFP.

- Conduct an integrated performance evaluation as part of the source selection process to determine if the integration on NDI components meet minimum needs.

- Perform all the IPT functions described in Sections III and IV of this guide.

Section VI. SOURCE SELECTION

A. BACKGROUND

Volume 3, Section II on IPPD tools and technologies describes the available or needed tools to comprehensively implement IPPD in a very large complex organization. Other smaller less complex organizations may require a less comprehensive IPPD tool kit. It is the intent of Section II to provide a shopping list of IPPD automation tools and technologies that can be used during source selection to evaluate a contractor's proposed method of implementing IPPD.

B. IPPD ASSESSMENT CRITERIA

Volume 3, Section II on IPPD tools and technologies describes the available or needed tools to comprehensively implement IPPD in a very large complex organization. Other smaller less complex organizations may require a less comprehensive IPPD tool kit. It is the intent of Section II to provide a shopping list of IPPD automation tools and technologies that can be used during source selection to evaluate a contractor's proposed method of implementing IPPD.

The proponent of this pamphlet is the United States Army Materiel Command. Users are invited to send comments and suggested improvements on DA Form 2028 (Recommended Changes to Publications and Blank Forms) to the Commander, HQ AMC, ATTN: AMCRD-IEC, 5001 Eisenhower Avenue, Alexandria, VA 22333-0001.

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GLOSSARY

ACT	ASARC Coordination Team
AMC	Army Materiel Command
AS	Acquisition Strategy
ASARC	Army System Acquisition Review Council
CAD	Computer Aided Design
CD	Combat Developer
CDR	Critical Design Review
CE	Concurrent Engineering
DA	Department of the Army
DOD	Department of Defense
ECP	Engineering Change Proposal
EMD	Engineering and Manufacturing Development
ICT	Integrated Concept Team
IIPT	Integrating Integrated Product Team
ILS	Integrated Logistics Support
IMP	Integrated Master Plan
IMS	Integrated Master Schedule
IPPD	Integrated Product and Process Development
IPPM	Integrated Product and Process Management
IPT	Integrated Product Team
MD	Materiel Developer
MDR	Milestone Decision Review
MSC	Major Subordinate Command
NDI	Nondevelopmental Item
OIPT	Overarching Integrated Product Team
OSD	Office of the Secretary of Defense
PDR	Preliminary Design Review
PM	Program/Project/Product Manager
PMO	Program Management Office
POC	Point of Contact
RFP	Request For Proposal
SDR	System Design Review
SOO	Statement of Objectives
SOW	Statement of Work
SSEB	Source Selection Evaluation Board
SSP	Source Selection Plan
STRICOM	Simulation, Training and Instrumentation Command
TDP	Technical Data Package
TRADOC	U.S. Army Training and Doctrine Command
VE	Value Engineering
WBS	Work Breakdown Structure
WIPT	Working-Level Integrated Product Team